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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/602,395	06/22/2000	John T. Moore	MI22-1384	8705

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EXAMINER

PHAM, THANHHA S

ART UNIT PAPER NUMBER

2813

DATE MAILED: 05/12/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/602,395

Applicant(s)

MOORE, JOHN T.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 04 April 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 7, 20, 25, 26, 27
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

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## DETAILED ACTION

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

**1. Claims 1-3 are rejected under 35 U.S.C. 102(e) as being anticipated by Mukhopadhyay [US 6,399,448].**

Mukhopadhyay, figs 1-4 and col 1-5, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising:

forming a nitrogen-comprising surface region layer (20A, fig 3, col 4 lines 30-44) across at least some of a silicon surface of a semiconductor substrate comprising a

monocrystalline silicon substrate (11, col 4 lines 1-3), the nitrogen-containing surface region extending no greater than 10 angstroms (*e.g. 5 angstroms, col 4 lines 39-44*) beneath the silicon surface; and

after forming the nitrogen-comprising layer, growing an oxide region comprising silicon dioxide (22, fig 4, col 5 lines 20-62) from the at least some of the semiconductor substrate, the oxide region having a thickness of at least about 70 angstroms (*e.g. 80 angstroms, col 5 lines 46*), the nitrogen of the nitrogen-comprising layer being dispersed with the oxide region (*nitrogen from the nitrogen-comprising layer 20A would be dispersed within the oxide region 22 due to diffusion of nitrogen atoms by heating while forming the oxide region by thermal oxidation*).

**2. Claims 1-3 and 12-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Yu et al [US 6,110,780].**

= With respect to claims 1-3, Yu et al, figs 1-5 and col 1-4, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising:

forming a nitrogen-comprising surface region layer (18, fig 2, col 2 lines 65-67 and col 3 lines 1-5) across at least some of a silicon surface of a semiconductor substrate comprising a monocrystalline silicon substrate (10, col 2 lines 49-50), the nitrogen-containing surface region extending no greater than 10 angstroms beneath the silicon surface (col 2 lines 65-67 and col 3 lines 1-6: *when the nitrogen comprising layer 18 is formed of about 10 angstroms by nitridation under a heat treatment with NO or N<sub>2</sub>O, the nitrogen comprising surface region (bottom surface of nitrogen comprising layer 18) would extend no greater than 10 angstroms beneath the silicon surface because reaction of nitrogen components to silicon atoms at silicon surface of the semiconductor substrate*); and

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after forming the nitrogen-comprising layer (18), growing an oxide region comprising silicon dioxide (28, *fig 5, col 3 lines 13-31*) from the at least some of the semiconductor substrate, the oxide region having a thickness of at least about 70 angstroms (*e.g. 70 angstroms, col 3 line 23*), the nitrogen of the nitrogen-comprising layer being dispersed with the oxide region (*nitrogen from the nitrogen-comprising layer 18 would be dispersed within the oxide region 28 by thermal oxidation the nitrogen-comprising layer 18*).

= With respect to claim 12, Yu et al, figs 1-5 and col 1-4, discloses the claimed method of forming a pair of oxide regions over a semiconductor substrate comprising:

forming a first oxide region (*16 on cell area C, fig 1, col 2 lines 61-64*) which covers only a portion of the semiconductor substrate (*10*);

forming a nitrogen-comprising layer (*fig 2, col 2 lines 65-67 and col 3 lines 1-5*) across at least some of the first oxide region (*figs 1-2 and col 2 lines 65-67: when the wafer of fig 1 is subjected to RTP of 900-950°C for 20-60 seconds in NO or N<sub>2</sub>O, nitridation is also performed on a surface of the first oxide region 16 on cell area C to form a nitrogen-comprising layer across at least some of the first oxide region*) and across at least some of the semiconductor substrate that is not covered by the first oxide region (*the nitrogen-comprising layer 18*), the nitrogen-comprising layer extending less than or equal 10 angstroms beneath a surface of the first oxide region (*when the first oxide region 16 on cell area C is exposed to NO or N<sub>2</sub>O in RTP of 900-950°C for 20-60 seconds, nitrogen component would react to the surface of the first oxide region 16, the nitrogen comprising layer extending less than or equal 10 angstrom beneath a surface of the first oxide region 16 would be formed*) and extending less than or equal 10 angstroms beneath a surface of the semiconductor substrate not covered by the first oxide region (*when the nitrogen comprising layer 18 is*

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*formed of about 10 angstroms by nitridation under a heat treatment with NO or N<sub>2</sub>O, the nitrogen comprising surface region (bottom surface of nitrogen comprising layer 18) would extend no greater than 10 angstroms beneath the silicon surface because reaction of nitrogen components to silicon atoms at silicon surface of the semiconductor substrate); and*

after forming the nitrogen-comprising layer, growing a second oxide region (28, *fig 5, col 3 lines 13-31*) from at least some of the semiconductor substrate that is not covered by the first oxide region, the second oxide region having a thickness of at least about 70 angstroms (*e.g. 70 angstroms, col 3 line 23*).

= With respect to claims 13-14, Yu et al (*fig 1, col 2 lines 40-64*) discloses the first oxide region (16 *on the cell area C*) is formed by:

forming an oxide layer over the covered regions (*cell area C, fig 1*) and at least some of the uncovered region (*periphery area P*) of the semiconductor substrate by exposing the semiconductor substrate (10) to oxidizing conditions; and

removing the oxide layer from over the uncovered region of the semiconductor substrate (*col 2 lines 61-62*).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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**3. Claims 4-11 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al [US 6,110,780] in view of Okumo et al [US 6,110,842]**

= With respect to claims 4-6, 9, and 15-16, Yu et al substantially discloses the claimed method except teaching forming the nitrogen-comprising surface region layer by remote plasma nitridation utilizing nitrogen species generated by a plasma least about 12 inches from the semiconductor substrate wherein the semiconductor substrate not being biased relative to the plasma during formation of the nitrogen-comprising layer. However, Okumo et al (*figs 1-6 and col 4-5*) discloses that using the remote plasma nitridation utilizing the nitrogen species generated by a plasma of about 12.5 inches from the semiconductor substrate wherein the semiconductor substrate can either be biased or non-biased relative to the plasma during forming of the nitrogen-comprising layer. The advantage of using the remote plasma nitridation of Okumo et al is to provide a better control of nitrogen profile in forming the nitrogen-comprising layer without degrading the gate oxide integrity of semiconductor device. Therefore, it would have been obvious for those skilled in the art to modify the process of Yu et al by using the remote plasma nitridation as being claimed, per taught by Okumo et al to provide a better control in forming the nitrogen-comprising layer thereby forming better oxide regions in the semiconductor device.

= With respect to claims 7-8 and 10-11, ranges of time and temperature for forming the nitrogen-comprising layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105

USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

**4. Claims 4-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mukhopadhyay et al [US 6,399,448] in view of Okumo et al [US 6,110,842].**

= With respect to claims 4-6, and 9, Mukhopadhyay et al substantially discloses the claimed method except teaching forming the nitrogen-comprising surface region layer by remote plasma nitridation utilizing nitrogen species generated by a plasma least about 12 inches from the semiconductor substrate wherein the semiconductor substrate not being biased relative to the plasma during formation of the nitrogen-comprising



layer. However, Okumo et al (*figs 1-6 and col 4-5*) discloses that using the remote plasma nitridation utilizing the nitrogen species generated by a plasma of about 12.5 inches from the semiconductor substrate wherein the semiconductor substrate can either be biased or non-biased relative to the plasma during forming of the nitrogen-comprising layer. The advantage of using the remote plasma nitridation of Okumo et al is to provide a better control of nitrogen profile in forming the nitrogen-comprising layer without degrading the gate oxide integrity of semiconductor device. Therefore, it would have been obvious for those skilled in the art to modify the process of Mukhopadhyay et al by using the remote plasma nitridation as being claimed, per taught by Okumo et al, to provide a better control in forming the nitrogen-comprising layer thereby forming better oxide regions in the semiconductor device.

= With respect to claims 7-8 and 10-11, ranges of time and temperature for forming the nitrogen-comprising layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-

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6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham  
May 4, 2003

  
CARL WHITEHEAD, JR.  
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